



Proximal humeral fracture-dislocation with axillary artery involvement treated with reverse shoulder arthroplasty

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Proximal humeral fractures are extremely common fracture patterns in the elderly population.^{1,2,4,6,7} These fractures typically occur without any associated neurologic or vascular injuries. A smaller subset has been reported to be accompanied by brachial neuropathy, which usually resolves with time. Axillary artery injury has been reported but is a much rarer event. Axillary artery injuries typically result from medial displacement of the proximal humeral shaft at the time of injury. We report a patient with a proximal humeral fracture-dislocation that involved a near axillary artery injury and an axillary nerve injury. The effects on subsequent reverse shoulder arthroplasty are detailed.

Case report

A 91-year-old man presented to the emergency department after a fall onto an outstretched hand. He was diagnosed with a proximal humeral fracture-dislocation. An attempt at reduction was performed in the emergency department. Orthopedics was consulted to participate in his care. The patient was seen in his hospital room, where he complained of diffuse right shoulder pain. He denied any neurologic symptoms. The physical examination noted swelling about his right shoulder. All compartments were soft. He was in a shoulder immobilizer.

His motor examination and vascular examination were intact distally. Assessing the sensation or motor function of his axillary nerve was difficult. Some sensation was definitely intact at the normal dis-

tribution of the axillary nerve although the patient had significant swelling and felt some decreased sensation around the entire shoulder. He had a strong palpable radial pulse, warm and pink fingertips, and good capillary refill.

Imaging studies consisted of x-ray imaging and a computed tomography scan. The images revealed a complex proximal humeral fracture with a large portion of the head displaced inferiorly (Figs. 1-3).

Treatment options were discussed with the patient at length. In particular, the options of nonsurgical treatment, hemiarthroplasty, and reverse total shoulder arthroplasty (RTSA) were discussed. The patient elected to proceed with an RTSA.

The patient was brought to the operative room 3 days after the injury. He was placed supine with his head elevated 20°, and a bump was placed under the scapula. After the shoulder was prepared and draped in the standard manner, the shoulder was approached with a standard deltopectoral incision. The fracture was identified and found to be a 3-part proximal humeral fracture. The shaft and greater tuberosity fragment were identified without difficulty. The humeral head fragment was absent from the joint. A large rent in the inferior joint capsule was found. With careful digital palpation, the head fragment was found approximately 8 cm below the joint capsule.

A Kocher was placed on the head fragment with the intention of retrieving it through the capsular rent and back into the joint. During retraction, the axillary artery was noted to be immediately anterior to the head fragment and in contact with the fragment. It was also noted that the fractured aspect of the head had several sharp edges that were directly in contact with the artery.

After careful deliberation, the vascular surgeons were consulted due to concern that the artery would become lacerated by the head fragment upon removal. The vascular surgeons were able to isolate the artery through the same approach with minimal dissection. They then were able to mobilize the artery and retract it

The patient provided verbal and written consent to publish this case report. Institutional Review Board approval was not required.

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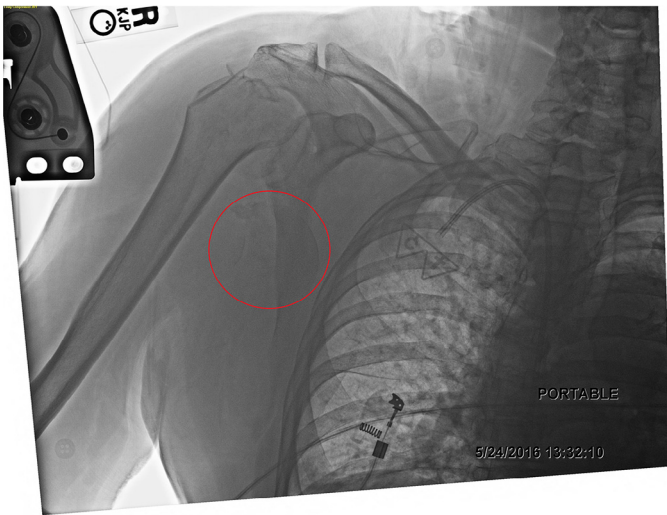


Figure 1 Initial portable anteroposterior x-ray image reveals humeral head displacement.

anteriorly, allowing for safe removal of the head fragment. The axillary nerve was also visualized during this approach and was found to be intact. For this reason, the plan was to continue to perform the RTSA, and the remainder of the procedure was performed without difficulty.

The patient’s hospital stay was uneventful. He was seen in clinic for follow-up at 1 month and 2 months. He remained in his sling for these 2 months without any physical therapy. Decreased sensation in the axillary nerve distribution was noted at the 2-month follow-up. His postoperative x-ray images also revealed laxity of the joint, likely due to deltoid dysfunction (Fig. 4). The patient was kept in a sling until the 3-month postoperative point and began physical therapy at this time.

Electromyography (EMG) and nerve conduction velocity (NCV) tests were also ordered at this time to determine the cause of his motor dysfunction. Testing confirmed axonal axillary motor



Figure 3 Coronal computed tomography scan reveals abnormal displacement of the humeral head fragment.



Figure 2 Axial computed tomography scan highlights the close proximity of the axillary artery (red arrow) and the humeral head fragment (black arrow).



Figure 4 Immediate postoperative x-ray image reveals poor tension on the arthroplasty implant due to decreased deltoid innervation.

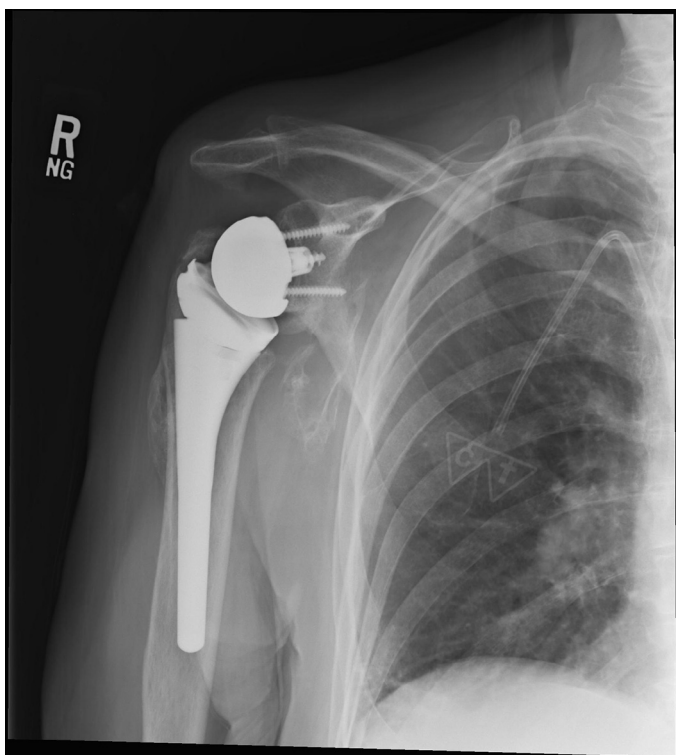


Figure 5 Postoperative x-ray image at 6 months reveals establishment of proper tension on the arthroplasty implant due to recovery of normal deltoid innervation.

neuropathy that he later regained at his 4-month follow-up appointment. His postoperative x-ray images at this time revealed improved tension of the arthroplasty implant (Fig. 5).

At 6 months of follow-up, he was able to elevate to 130°. At 1 year of follow-up, he had forward flexion to 140°, abduction to 140°, external rotation of 50°, and internal rotation of 30°. He had sensation at his axillary nerve distribution, and his deltoid was functioning normally.

Discussion

Axillary artery injuries associated with proximal humeral fractures are rare but have been reported.^{3,5,12–15,17} Most often these injuries occur at the time of the injury, although some cases have been reported to have happened during attempted reduction. Most of these cases have involved Neer 2-part fractures with medialization of the humeral shaft that have caused laceration or thrombosis of the artery. Thorsness et al¹⁸ reported a series of 3 patients with proximal humeral fractures with associated axillary artery injury, resulting in 1 death. The authors performed a review of the English language literature at that time and found an additional 11 cases, demonstrating the rarity of this combined injury. Menendez et al¹³ reviewed a population of 388,676 proximal humeral fractures to determine the incidence. They found that 331 of these fractures had an accompanying axillary artery injury for a rate of 8.5 per 10,000. We found no documented cases of axillary artery injury that occurred during removal of a humeral head fragment.

The case presented here is unique in that it demonstrates the potential risk to the axillary artery during the surgical treatment of these fractures. We have not found similar cases reported of the unique potential for axillary artery injury when the humeral head fragment is ejected from the joint. In this case, the head fragment was ejected from the joint with its articular side first. The energy from the fracture propelled it past the axillary artery, which we

assumed was protected by the smooth articular cartilage as the fragment came to lie just past the artery but in contact with it. The spicules from the fracture then posed a significant risk of injury to the artery because they were now directly facing the artery during removal of the fragment. Close review of Fig. 2, an axial CT scan without contrast, demonstrates how close the axillary artery (red arrow) was to the humeral head fragment (black arrow).

Deltoid function is a prerequisite of a successful outcome after RTSA. In this case, the patient likely sustained an axillary nerve injury with the initial fracture-dislocation. The function of the axillary nerve is not always easy to determine in the acute setting. The axillary nerve was intact at the time of surgery, and fortunately, function recovered with time, causing no permanent sequelae. Axillary nerve injuries in general have been reported with relative frequency after shoulder arthroplasty and are more common after RTSA.⁸ Many case reports of axillary nerve injury after shoulder arthroplasty exist, and fortunately, most are transient.^{11,16,19} These are believed to be mostly the result of lengthening the limb girdle causing a transient neurapraxia.^{8–10}

Appropriate precautions should be taken if an axillary nerve injury is noted after a RTSA, including prolonged sling immobilization to reduce the risk of dislocation. Sling immobilization should be continued until there is evidence of axillary nerve function returning. The return of axillary nerve function can be determined by physical examination of sensation or axillary nerve motor function. In addition, the restoration of anatomic compression of the RTSA on radiographs also serves as evidence of the return of axillary nerve function.

Here we present a case of axillary nerve dysfunction that recovered with time, and joint stability was restored. If axillary nerve dysfunction is noted after RTSA, the surgeon should take precautions to avoid instability while awaiting the return of nerve function.

Conclusion

Surgeons need to be aware of the potential for axillary artery injury during removal of the head fragment during treatment of proximal humeral fractures. When the head fragment is displaced beyond what would be expected to be the normal capsular area, suspicion should be particularly high. If the relationship between the head fragment and the axillary artery cannot be easily discerned, a CT angiogram is indicated to better assist in planning the surgical approach. In addition, a low threshold should exist for a vascular surgery consult.

Disclaimer

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